Free radical generation by ultrasound in aqueous solutions: EPR and spin trapping studies.

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The primary free radical species generated by sonolysis of argon-saturated aqueous solutions (i.e., $^{\bullet}H$, $^{\bullet}OH$, $O_2^{\bullet-}$) and in N_2 -containing aqueous solutions ($^{\bullet}H$, $^{\bullet}OH$, $O_2^{\bullet-}$ and $NO^{\bullet}$) were identified by EPR and spin trapping. Spin trapping experiments using Cd^{2+} as scavenger show that no detectable level of hydrated electrons is found in the sonolysis of water at neutral pH. In aqueous solutions free radicals can also be produced by 1 MHz ultrasound under microsecond pulse conditions.The approximate temperature of O-H bond pyrolysis in collapsing bubbles in argon -saturated aqueous solutions ~(2000-4000 K) was estimated by studies of the kinetic isotope effect in the sonolysis of 1:1 H_2O-D_2O mixtures using PBN-type spin traps.

Our current understanding of the mechanisms of sonodynamic therapy (i.e., the ultrasound dependent enhancement of the cytotoxicity of certain drugs) with potential application to cancer therapy will be discussed [1]. The evidence suggests that sonosensitization is due to the chemical activation of sonosensitizers inside or in close vicinity of hot cavitation bubbles to form sensitizer-derived radicals either by direct pyrolysis or due to the reaction of $^{\bullet}H$ and $^{\bullet}OH$ radicals.

Recently the role of the Gibbs surface excess of solutes in the sonochemistry of aqueous surfactant solutions has been investigated by spin trapping. It was found that the Gibbs surface excess of certain high molecular weight non-volatile surfactants does not correlate with the extent of their sonolytic decomposition.

[1] Vladimir Mišík and Peter Riesz, Ann. N.Y. Acad. Sci. 899, 335-348, 2000